Operating Instructions

FM/AM SIGNAL GENERATOR

Type TF 995A/5

MARCONI INSTRUMENTS LIMITED, ENGLAND

Electronic Services, Los Angeles
M14055X

MP MASTER
MA30915

SUPPLIED AND SERVICED BY:
MARCONI INSTRUMENTS
111 CEDAR LANE
ENGLEWOOD N. J.

OPERATING INSTRUCTIONS

for

F.M./A.M. SIGNAL GENERATOR

TYPE TF 995A/5

CONTENTS

Ref.		Page
	SCHEDULE OF PARTS SUPPLIED	iv
	DATA SUMMARY	v
1.	DESCRIPTION	
1.1	GENERAL	1
2.	OPERATION	
2.1	INSTALLATION	2
2.2	SWITCHING ON AND WARMING UP	2
2.3	CONNECTING TO EQUIPMENT UNDER TEST	2
2.4	TUNING	3
2.4.1	General tuning	3
2.4.2	Crystal Calibrator and its use	4
2.4.3	Incremental Frequency Controls	6
2.4.4	Interpolating Dial	7
2.5	SETTING UP FOR C.W. OR MODULATED OUTPUT	9
2.5.1	Continuous Wave	10
2.5.2	Amplitude Modulation	10
2.5.3	Frequency Modulation	11
2.5.4	Simultaneous A.M. and F.M.	14
2.6.	R.F. OUTPUT ARRANGEMENTS	14
2.6.1	Outputs from 1 μV to 100 mV at 52 and 75 ohms	16
2.6.2	Outputs from 2 μV to 200 mV at 75 ohms only	16
2.6.3	Outputs from 0.1 μV to 10 mV at 52 and 75 ohms	17
2.6.4	Output in terms of volage developed across external load	17
2.7	SYNCHRONIZING SIGNAL	18
3.	TECHNICAL DESCRIPTION	
3.1	R.F. CIRCUITS	19
3.2	MODULATION SYSTEMS	20
3.3	MONITORING ARRANGEMENTS	21
3.4	POWER UNIT	21

Section

4. MAINTENANCE Page

4.1 ACCESS TO COMPONENTS 22
4.1.1 Removal from Case 22
4.1.2 Removal of R.F. Unit Cover 22
4.1.3 Removal of Monitor Diode (X2) Cover 22
4.2 MAINS INPUT CONNECTIONS 23
4.3. WORKING VOLTAGES 23
4.3.1 Power Supply Voltages 24
4.3.2 Valve Electrode Voltages 24

5 DRAWINGS Ref.

CIRCUIT DIAGRAM ..... TD 23080/5
BLOCK SCHEMATIC DIAGRAM ..... XD 32864

6 APPENDIX

DECIBEL CONVERSION TABLE ..... OM G-SUPP DB

SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items:

1. One F.M./A.M. Signal Generator Type TF 995A/5 complete with valves, etc., as under:-

Valves:	Six:	Type 6AK5, Pentodes.
	One:	Type 6AK6, Pentode.
	One:	Type 6AL5, Double Diode.
	One:	Type 6AU6, Pentode.
	One:	Type EF86, Pentode.
	Two:	Type 12AT7, Double Triodes.
	One:	Type 5Z4G, Full-Wave Rectifier.
	One:	Type 0A2, Voltage Stabilizer.
	One:	Type 5651, Voltage Stabilizer.
Lamp:	One:	6.3-volt, 0.3-amp, M.E.S., Pilot Lamp.
Oscillator Crystal:	One:	333.3 kc/s, Marconi Type 1655C.
Semiconductors:	One:	Type CS2-A Silicon Diode.
	Two:	Type CG1-E Germanum Diodes.

2. One Terminating Unit Type TM 5551; 75 ohms in, 52 and 75 ohms out.

3. Two coaxial Free Plugs; Type BNC; one 50-ohm (UG-88/U), one 75-ohm (UG-260/U), for Terminating Unit outlets.

4. One Jack Plug, S.T.C. Type 4006; for Crystal Check socket.

5. One Operating Instructions No. EB 995A/5.

ACCESSORIES AVAILABLE

20-dB attenuator Pad, Type TM 5552, for use between output cable and Terminating Unit; 75-ohm BNC connectors.

SPARES

No spares are supplied unless specially ordered.

DATA SUMMARY

for

F.M./A.M. Signal Generator Type TF 995A/5

Serial No. JA311/001 and above

FREQUENCY

Range: 1.5 to 220 Mc/s in five bands:

(1) 1.5 to 13.5 Mc/s
(2) 13.5 to 27.5 Mc/s
(3) 27 to 55 Mc/s
(4) 54 to 110 Mc/s
(5) 108 to 220 Mc/s

Calibration Accuracy: From 13.5 to 220 Mc/s the calibration of the main frequency dial is accurate to within 1%; a higher frequency accuracy than this can be obtained using the built-in crystal calibrator which provides 14 check points, to an accuracy of 2 parts in 10_4, on each of the four higher-frequency bands. From 1.5 to 13.5 Mc/s the frequency calibration has an average accuracy of 3%.

Stability: After warm-up, drift is not greater than 0.002% in a 10-minute period, except on the lowest band.

Fine Tuning Control: A fine tuning control is provided; this is uncalibrated and has a total cover of approximately 24 Kc/s on band 5, 12 kc/s on band 4, 6 kc/s on bands 3 and 1, and 3 kc/s on band 2.

Incremental Controls: Both stepped and continuously variable calibrated controls are provided. The stepped control enables the carrier frequency to be shifted by ±40 and ±20 kc/s on bands 5 and 4, ±20 and ±10 kc/s on bands 3 and 1, and ±10 and ±5 kc/s on band 2. The continuous control has a cover of ±0.75 of one increment of the stepped control on any band, e.g., cover is ±15 kc/s on bands 5 and 4.

OUTPUT

Voltage:	Coarse and fine 75-ohm attenuators connected in cascade provide - in conjunction with the 52- and 75-ohm outlets of a Terminating Unit - a source e.m.f. variable in 2-dB steps from 1 μV to 100 mV. The r.f. level meter carries a ±1-dB calibration to allow interpolation between the 2-dB attenuator steps. The accuracy of the joint indication of the attenuators and level meter is within 1 dB ±0.25 μV up to 100 Mc/s, and within 2 dB ±0.25 μV up to 220 Mc/s.
High Outputs:	Source e.m.f.'s up to 200 mV at an impedance of 75 ohms are obtained direct from the Generator output cable.
Low Outputs:	Source e.m.f.'s down to a nominal 0.1 μV at impedances of both 52 and 75 ohms are obtained by inserting 20-dB Attenuator Pad TM 5552 between the generator output cable and Terminating Unit.

MODULATION

F.M.	Normal deviation continuously variable from 0 to 5 kc/s and 0 to 15 kc/s on all bands; the accuracy at maximum deviation at 1000 c/s is ±5% of f.s.d., with a possible additional variation of ±10% due to valve aging or random replacement. High deviaition of x 2 normal is also available on bands 1 and 3, x 4 normal on band 4, and x 8 normal on band 5. Internal modulation at 400 c/s, 1 kc/s, or 1.5 kc/s, with modulation distortion not exceeding 2% at maximum deviation. External modulation characteristic flat within 1 dB, 50 c/s to 15 kc/s with respect to 1,000 c/s.
Spurious F.M. on C.W.:	The spurious f.m. due to hum does not exceed 25 c/s deviaition at any carrier frequency. The unusually low level of spurious noise modulation allows full use of the Generator for adjacent-channel testing on receivers designed for systems employing channel separations as small as 22.5 kc/s.

A.M.	Internal at 400 c/s, 1 kc/s, and 1.5 kc/s to a depth variable up to 50% with distortion not exceeding 6% at 30% depth. External frequency characteristic (with input adjusted for constant modulation-meter reading) is flat within 0.5 dB from 100 c/s to 10 kc/s.
A.M. Depth Indication:	Accurate to within 5% modulation.
Synchronizing Signal:	Available at 400 c/s, 1 kc/s, or 1.5 kc/s.
POWER SUPPLY:	200 to 250 volts, or 100 to 150 volts after adjusting internal link, 40 to 65 c/s; 65 watts. Models supplied ready for immediate 100- to 150-volt use if specified at time of ordering.

DIMENSIONS AND WEIGHT:

Height	Width	Depth	Weight
13 in (33 cm)	17½ (44 cm)	8½ in (22 cm)	33 lb (15 kg)

1 DESCRIPTION

1.1 GENERAL

The Marconi F.M./A.M. Signal Generator TF 995A/5 covers the frequency range of 1.5 to 220 Mc/s in five bands. Its output can be unmodulated, frequency modulated, or amplitude modulated; if required, both frequency and amplitude modulation can be applied simultaneously. The modulation is obtained from either an internal 3-frequency oscillator, or an external source.

The open-circuit output voltage is variable by means of resistive step attenuators from 1 μV to 100 mV at 52 ohms and 1 μV to 200 mV at 75 ohms. A plug-in 20-dB Attenuator Pad, available as an optional accessory extends the range down to 0.1 μV at both impedances.

The high-discrimination tuning required for testing narrow-band systems is facilitated by the inclusion of a fine tuning control. In addition, small known changes in carrier frequency can be made by means of two directly-calibrated incremental-frequency controls; one of these controls gives a stepped adjustment while the other allows continuous interpolation between steps. On the two highest bands, the stepped control provides shifts of 20 and 40 kc/s in either direction and the calibration marks on the continuous control are only 1 kc/s apart; on the lower bands, the total shift is determined by a simple division of the reading on both dials.

A high degree of frequency stability has been achieved by use of temperature-compensating components; after warm-up, drift is less than 400 c/s per minute at a carrier frequency of 200 Mc/s.

The inclusion of a CARRIER on/off switch makes it possible for the Generator output to be temporarily interrupted without affecting the output impedance; this facilitates a number of two-signal receiver tests such as intermodulation and blocking which involves the simultaneous use of two signal generators. Spurious f.m. due to hum is less than 25 c/s deviation, and the low level of noise modulation makes the TF 995A/5 fully suitable for applications such as adjacent-channel testing on receiver systems using a channel separation of 25 kc/s or less.

2 OPERATION

2.1 INSTALLATION

Unless otherwise specified, the Signal Generator is normally despatched with its valves in position and with its mains input circuit adjusted for immediate use with a 240-volt, 40- to 65-c/s mains supply. The instrument can be adjusted for operation from any other 40- to 65-c/s supply voltage in the ranges 200 to 250 and 100 to 150 volts. To check or alter the settings of the mains transformer tappings, the user should refer to MAINTENANCE - Section 4.2.

2.2 SWITCHING ON AND WARMING UP

Before switching ON, be quite sure that the instrument in correctly adjusted to suit the particular mains supply to which it is to be connected. Then proceed as follows:-

(1) Connect the mains lead - stowed in the left-hand case-handle recess - to the mains supply socket.

(2) Switch ON by means of the SUPPLY switch; the red pilot lamp should now glow.

(3) Before proceeding further, allow a short time - say five minutes - to elapse for the internal circuits to warm up. If a particularly high standard of frequency stability is required, this time should be increased to about 30 minutes.

2.3 CONNECTING TO THE EQUIPMENT UNDER TEST

The r.f. output from the Signal Generator is derived via a permanently attached coaxial cable fitted with a free socket. This socket mates with the following type of BNC coaxial connectors:-

	75 ohm	50 ohm
Great Britain, Air Ministry:	10H/20946	10H/20935
Films and Equipment:	UG-260/U	UG-88/U
Transradio Ltd. :	BN. 1/7	BN. 1/5
Belling and Lee :		L. 1331/FP
United States, Military No.:	UG-260/U	UG-88/U

The separate dual-output impedance TERMINATING UNIT has a fixed-plug inlet which mates with the free socket on the output cable. The two outlets are fixed BNC sockets, and these mate with the free plugs supplied with the instrument.

2.3 (continued)

The 20-dB ATTENUATOR PAD, available as an optional accessory, is fitted with an input socket, and an outplut plug, so that it can be inserted between the output cable and the TERMINATING UNIT for use when a low output is required.

2.4. TUNING

The various aspects of tuning the Generator are dealt with in the following sections.

General tuning: Section 2.4.1.
Standardizing frequency against crystal oscillator: Section 2.4.2.
Use of incremental frequency controls: Section 2.4.3.
Interpolation of main frequency scales: Section 2.4.4.

2.4.1 General Tuning

The TF 995A/5 covers the range 1.5 to 220 Mc/s in five bands as follows:-

1.5 to 13.5 Mc/s
13.5 to 27.5 Mc/s
27 to 55 Mc/s
54 to 110 Mc/s
108 to 220 Mc/s

The particular band required is selected by means of the range switch. Rotation of the COARSE TUNE control varies the output frequency within the limits of the band selected, and moves the main dial relative to its cursor. The FINE TUNE control has a very small coverage and is incorporated to assist in the precise tuning required in tests involving narrow-band equipment. The total coverage of this control on each band is as follows:-

1.5 to 13.5 Mc/s	band: approximately	6 kc/s
13.5 to 27.5 Mc/s	" : "	3 kc/s
27 to 55 Mc/s	" : "	6 kc/s
54 to 110 Mc/s	" : "	12 kc/s
108 to 220 Mc/s	" : "	24 kc/s

The Signal Generator has a built-in crystal calibrator, and the cursor of the main tuning dial is mounted so that its angular position relative to that of the dial is variable over a small arc by movement of a milled boss at the centre of the dial. This movable cursor enables the operator to standardize the frequency scale of the Signal Generator at any time; the cursor is used in conjunction with the crystal calibrator in the manner described in Section 2.4.2.

2.4.1 (continued)

In addition to the RANGE switch and the TUNE control, the instrument is fitted with directly-calibrated incremental-frequency controls; the method of using these controls is described fully in Section 2.4.3. Section 2.4.4 deals with the method of interpolating between main dial markings by means of the linearly calibrated dial on the COARSE TUNE control.

2.4.2 The Crystal Calibrator and its Use in Standardizing the Frequency Scale

(a) Introduction

The calibrator, or crystal oscillator, has a fundamental frequency of 333.3 kc/s and is coupled to the basic 4.5- to 9.16-Mc/s r.f. oscillator which feeds the multiplier chain. Plugging a pair of high-resistance headphones into the CRYSTAL CHECK jack socket automatically brings the calibrator circuit into use; with the aid of the headphones, the difference frequency between the basic oscillator and the harmonic multiples of the calibrator's 333.3 kc/s can be monitored aurally.

Because the outputs on the four higher-frequency bands are all derived directly from the multiplier chain, their frequencies have an exact integral relationship to the frequency of the basic oscillator. It follows, therefore, that setting the TUNE control to bring the basic-oscillator frequency to that of a crystal harmonic will also bring the frequency of the outputs from the multiplier chain to a known relationship with the crystal harmonic, and allow the frequency dial to be standardized with a high degree of accuracy.

Outputs on the lowest-frequency of 1.5- to 13.5-Mc/s band are not derived directly from the multiplier chain; their generation involves a heterodyne action between the 27- to 55-Mc/s multiplier and a 30-Mc/s fixed oscillator which is not locked to the basic oscillator. For this reason, although use is made of the crystal calibrator when setting up for 1.5- to 13.5-Mc/s outputs, the accuracy of standardization is of a lower order than that obtained on the four higher-frequency ranges.

(b) Check-Point Frequencies

The calibrator provides a total of 56 check points between 13.5 and 220 Mc/s; these check points occur as follows:-

13.5 - 27.5 Mc/s band:	At 14, 15 and 16 Mc/s, and every calibration point which is a multiple of 1 Mc/s, to 27 Mc/s.
27 - 55 Mc/s band:	At 28, 30 and 32 Mc/s, and every calibration point which is a multiple of 2 Mc/s, to 54 Mc/s.
54 - 110 Mc/s band:	At 56, 60 and 64 Mc/s, and every calibration point which is a multiple of 4 Mc/s, to 108 Mc/s.

2.4.2 (continued)

108 - 220 Mc/s band: At 112, 120, and 128 Mc/s, and every calibration point which is a multiple of 8 Mc/s, to 216 Mc/s.

(c) Standardization Procedure

As shown above, the calibrator allows the frequency scale to be checked at 14 different points on each of the above bands, and the adjustable cursor can be set to correspond exactly with any one of these points.

When the Signal Generator is to be used above 13.5 Mc/s to provide an output at a single spot frequency, or over a narrow band of frequencies, the cursor should be set up at the nearest crystal check point.

When the Signal Generator is to be used over a wide range of frequencies, and it is inconvenient to reset the cursor for each material frequency change, or, alternatively, when using the 1.5- to 13.5-Mc/s band, the procedure is varied to reduce the mean error to a minimum. The method of standardizing the frequency scale for subsequent general use is as follows:-

(1) Set the INC. FREQ. controls to zero and the FINE TUNE control to mid-position.

(2) Set the RANGE switch to 13.5 - 27.5 Mc/s.

(3) Using the headphones plugged into the CRYSTAL CHECK jack socket, tune the main dial to a crystal check point near the centre of the band; e.g., 20 Mc/s.

When using the calibrator, the MOD SELECTOR must be set to a position other than INT MOD - F.M. or EXT MOD - F.M. This ensures that the variable oscillator is not being frequency modulated - a condition which prevents precise setting of the TUNE control for the lowest-frequency beat note in the headphones, since it gives rise to a fluctuating tone.

After using the calibrator, the Signal Generator can, of course, be subsequently set up for f.m. without invalidating any frequency calibration previously obtained by use of the calibrator.

(4) Adjust the milled boss in the centre of the dial to bring the cursor exactly in line with the calibration mark corresponding to the crystal check point.

If the Signal Generator has been out of use for some time, it may be necessary to use a coin in the slot provided, in order to rotate the milled boss.

2.4.2 (continued)

(5) Check the calibration accuracy at several crystal check points both above and below the check point at which the cursor was set in (4) above.

(6) Readjust the cursor setting to equalize the errors over the band; e.g., it might be found that, with the frequency scale indication correct at 20 Mc/s, the indication was high at both 15 and 25 Mc/s - in such a case, the errors would be equalized by making the indication a little low at 20 Mc/s, and thus not so high at 15 and 25 Mc/s.

It will be noted that, in the above procedure, the frequency scale is standardized on the 13.5- to 27.5-Mc/s band. This band is specified since its corresponding scale calibrations occupy the longest arc on the dial. The dial can therefore be read with a high degree of discrimination on this band and the correct cursor setting most easily determined. Once the frequency scale has been standardized on the 13.5- to 27.5-Mc/s band, the cursor is correctly set to give the minimum mean error on the other three direct-multiple bands. It is also correctly set for the 1.5- to 13.5-Mc/s band.

When standardized in this way, the main tuning dial indication for frequencies above 13.5 Mc/s is accurate to at least 1%, and will generally be within 0.5%; for frequencies below 13.5 Mc/s, the average error does not exceed 3%.

2.4.3. The Incremental Frequency Controls

These controls provide a convenient means of producing small, accurately known changes in carrier frequency. Since they are not connected directly to the r.f. oscillator, either mechanically or electrically, but operate by varying the d.c. voltage at the grid of the reactor valve, the controls are completely free from any sort of backlash. This attribute, together with the directly calibrated scales, renders the controls very suitable for bandwidth or similar measurements.

To use the controls proceed as follows:-

(1) With the INC. FREQ. dials set to their centre-zero position, tune the Signal Generator to the centre frequency of the equipment under test by means of the TUNE controls.

(2) Rotate the INC. FREQ. controls by the amount necessary to produce the required frequency shift or the required change in response depending on the method of measurement.

The scales of the INC. FREQ. Dials are direct-reading on the 54 to 110 and 108 to 220 Mc/s bands. For each of the other bands, a multiplying factor must be applied, the appropriate factor for each frequency band is engraved on the front panel adjacent to the RANGE switch marking. The multiplying factors are also given below in TABLE 1.

2.4.3 (continued)

TABLE 1

RANGE switch setting (Mc/s)	Total coverage of INC. FREQ. controls (kc/s)	Multiply INC. FREQ. dial readings by	Incremental Frequency change per division (kc/s per div)	
			COARSE	FINE
1.5 - 13.5	±27.5	0.5	10	0.5
13.5 - 27.5	±13.75	0.25	5	0.25
27 - 55	±27.5	0.5	10	0.5
54 - 110	±55	1	20	1
108 - 220	±55	1	20	1

2.4.4 The Interpolating Dial

The COARSE TUNE control knob is fitted with a small dial calibrated linearly from 0 to 100 over its total circumference and makes approximately 17 revolutions as the main dial is turned through its complete angle of rotation.

This dial may be used to subdivide linearly any portion of the frequency coverage on any band in order to tune accurately to a frequency above 13.5 Mc/s which does not coincide with a crystal check point. The method of using the dial for this purpose is described in the following instructions:-

(1) Set the INC. FREQ. controls to zero.

(2) Set the RANGE switch to whichever of the four higher-frequency bands includes the required frequency.

(3) Tune the Signal Generator to the nearest crystal check point below the required frequency - as indicated on the main tuning dial - identifying the point with the aid of headphones plugged into the CRYSTAL CHECK jack socket on the front panel, and noting the interpolating dial reading for the lowest frequency beat note.

2.4.4 (continued)

(4) Tune the Signal Generator to the nearest crystal check point above the required frequency and note the change of reading of the interpolating dial. It is important that the total change is noted when the dial is turned through more than one revolution.

(5) From the difference in frequency between the two crystal check points, and the total number of interpolating dial divisions traversed in tuning the Signal Generator from one crystal check point to the other, calculate the frequency change per division of the interplating dial; this change may conveniently be expressed in kc/s per division.

(6) With the aid of the headphones, reset the main tuning dial to the crystal check point below the required frequency.

(7) Rotate the TUNE control so that the interpolating dial traverses the correct number of divisions to give the required output frequency.

It is recommended that the required frequency is always approached from the low-frequency side in order to eliminate the possibility of error due to backlash.

The following example, obtained by manipulation of the controls of a particular TF 995A/5, illustrates the use of the interpolating dial to obtain an output from the instrument at an accurate frequency of 74.25 Mc/s.

Example: With the TUNE control set to the crystal check point at 72 Mc/s, the interpolating dial reading was 17. With the TUNE control set to the crystal check point at 76 Mc/s the new reading on the auxiliary dial was 40. The total number of interpolating dial divisions traversed was 123, the dial having rotated through slightly more than one revolution for the frequency change of 4 Mc/s, i.e. 4,000 kc/s. In this case, a change of 1 division on the interplating dial corresponded, between 72 and 76 Mc/s, to a nominal frequency change of

$$\frac{4000}{123} = 32.5 \text{ kc/s}$$

Therefore, by starting from the original auxiliary dial setting at 72 Mc/s (72,000 kc/s) the required frequency of 74.25 Mc/s (74,250 kc/s) was obtained by rotating the auxiliary dial through

$$\frac{74,250 - 72,000}{32.5} = \frac{2250}{32.5} = 69 \text{ divisions}$$

Since it will be appreciated that the figures given in the above example can only be considered as typical, it follows that the relationship of frequency change to change in interpolating dial setting should be

2.4.4 (continued)

determined **individually** by the user - in the manner outlined in this Section - on the particular TF 995A/5 he is using.

The relationship should be determined between the crystal check points which embrace the particular section of the frequency band over which incremental variations are to be made. Also, the relationship should be redetermined for each different section of the frequency band, since it varies, not only from band to band, but also for different sections of any one band.

The interpolating dial can also, of course, be calibrated in kc/s per division for any portion of the 1.5- to 13.5-Mc/s band. Crystal check points cannot be used in this band, but the movement of the auxiliary dial for any frequency interval can be determined against the appropriate main dial calibration markings, and accurate interpolation between these marks carried out as previously described for the higher-frequency ranges.

2.5 SETTING UP FOR CONTINUOUS WAVE OR MODULATED OUTPUT

The Signal Generator includes facilities which allow the following types of r.f. output to be obtained:-

(1) Continuous Wave (see Section 2.5.1.)

(2) Amplitude Modulated (see Section 2.5.2.), variable to 50% depth,

  (a) from the internal a.f. oscillator at 400, 1000, or 1500 c/s,

  (b) from an external sinewave source, within the range 100 c/s to 10 kc/s.

(3) Frequency Modulated (see Section 2.5.3.), variable to maximum frequency deviations ranging from 15 kc/s to 120 kc/s,

  (a) from the internal a.f. oscillator at 400, 100, or 1500 c/s;

  (b) from an external sinewave source, within the range 50 c/s to 15 kc/s.

(4) Simultaneously Frequency and Amplitude Modulated (see Section 2.5.4.), the Amplitude Modulation being obtained from the internal a.f. oscillator, and the Frequency Modulation from an external source as (3)(b), above.

When setting up for amplitude or frequency modulation as described in Sections 2.5.2. and 2.5.3., it may be observed that, with the METER READS key held to either A.M. or F.M., as applies, the apparent modulation as measured on external apparatus is less than that indicated on the meter.

2.5 (continued)

This is quite in order; the meter indicates the modulation which will be obtained when the switch is returned to its central position and the meter reverts to its normal function of monitoring the r.f. level.

2.5.1 Continuous Wave

(1) Set the MOD SELECTOR switch to C.W.

(2) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

2.5.2 Amplitude Modulation

(a) From the internal 3-frequency oscillator

(1) Set the MOD SELECTOR switch to INT MOD - A.M.

(2) Turn the SET MOD. FREQ. to give the required modulation frequency - 400, 1000, or 1500 c/s.

(3) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(4) With the METER READS key switch held in the A.M. position, adjust the SET MOD control to the required modulation depth, as indicated on the top scale of the panel meter. Amplitude modulation is variable to a maximum depth of 50%.

(5) Release the METER READS key switch and, if necessary, repeat (3) above.

(b) From an external a.f. source.

(1) Set the MOD SELECTOR switch to EXT MOD - A.M.

(2) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(3) Connect the external modulation source to the EXT MOD and E terminals.

(4) With the METER READS key switch held in the A.M. position, adjust the SET MOD control to the required modulation depth, as indicated on the top scale of the panel meter. With the SET MOD control at maximum, an input of approximately 15 volts r.m.s. is required at the EXT MOD and E TERMINALS to produce 30% modulation depth within the modulation frequency range 100 c/s to 10 kc/s.

2.5.2 (continued)

(5) Release the METER READS key switch and, if necessary, repeat (2), above.

2.5.3 Frequency Modulation

In addition to the MOD SELECTOR and SET MOD. FREQ. switches, there are three other controls concerned in setting up the carrier deviation when the output from the Signal Generator is to be frequency modulated. These controls are the continuously-variable SET MOD potentiometer, the DEVIATION RANGE switch, and the DEVIATION - NORMAL/HIGH switch. When the METER READS key switch is held to F.M., the panel meter indicates deviation. The meter has two deviation scales: one calibrated from 0 to 5 kc/s, and the other from 0 to 15 kc/s.

With the DEVIATION - NORMAL/HIGH switch set to NORMAL, the meter scale appropriate to the setting of the DEVIATION RANGE switch is used and the deviation is as indicated by the meter for all settings of the carrier-frequency range switch.

With the DEVIATION - NORMAL/HIGH switch set to HIGH, the deviation obtained on the 13.5- to 27.5-Mc/s band is the same as with the switch set to NORMAL. For all other carrier-frequency bands the deviation is increased and the meter readings - again, taken on the scale appropriate to the settings of the DEVIATION RANGE switch - must be multiplied in accordance with TABLE 2 overleaf.

2.5.3 (continued)

TABLE 2

RANGE switch setting (Mc/s)	DEVIATION RANGE switch setting (kc/s)	DEVIATION - NORMAL/HIGH switch set to HIGH	
		Multiply meter reading by	Maximum deviation obtainable (kc/s)
1.5 - 13.5	5	2	10
	15	2	30
13.5 - 27.5	5	1	5
	15	1	15
27 - 55	5	2	10
	15	2	30
54 - 110	5	4	20
	15	4	60
108 - 220	5	8	40
	15	8	120

The following example shows the method of determining the meter reading for a required deviation which is greater than 15 kc/s and thus necessitates setting the DEVIATION - NORMAL/HIGH switch to HIGH.

2.5.3 (continued)

Example: A deviation of 36 kc/s is required at a carrier frequency of 80 Mc/s. The carrier frequency lies within the 54- to 110-Mc/s band. The meter multiplying factor for this band is 4; therefore, for 36 kc/s deviation, the meter should be set (by means of the SET MOD control) to read

$$\frac{36}{4} = 9 \text{ kc/s}$$

Do this on the bottom scale of the meter with the DEVIATION RANGE switch set to 15 kc/s.

(a) F.M. from the internal 3-frequency oscillator

(1) Set the MOD SELECTOR switch to INT MOD - F.M.

(2) Turn the SET MOD. FREQ. switch to give the required modulation frequency - 400, 1000, or 1500 c/s.

(3) Set the DEVIATION RANGE switch as required. If, at carrier frequencies less than 13.5 Mc/s, or greater than 27.5 Mc/s, more than 15 kc/s deviation is required, set the DEVIATION - NORMAL/HIGH switch to HIGH. (Deviations greater than 15 kc/s are not obtainable on the 13.5- to 27.5-Mc/s carrier-frequency band, the maximum deviations obtainable on the other carrier-frequency bands are given earlier in TABLE 2.)

(4) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(5) With the METER READS key switch held to F.M., adjust the SET MOD control until the required deviation is indicated on the panel meter; read the meter on its middle scale when the DEVIATION range switch is set to 5 kc/s, and read on the lower scale when the switch is set to 15 kc/s. If the DEVIATION - NORMAL/HIGH switch is set to HIGH, the meter readings must be multiplied by the appropriate factor given in TABLE 2.

(6) Release the METER READS key switch and, if necessary, repeat (4) above.

(b) F.M. from an external source

(1) Set the MOD SELECTOR switch to EXT MOD - F.M.

(2) Set the DEVIATION RANGE switch as required. If at carrier frequencies less than 13.5 Mc/s, or greater than 27.5 Mc/s, more than 15 kc/s deviation is required, set the DEVIATION -

2.5.3 (continued)

NORMAL/HIGH switch to HIGH. (Deviations greater than 15 kc/s are not obtainable on the 13.5- to 27.5-Mc/s carrier-frequency band; the maximum deviations obtainable on the other carrier-frequency bands are given earlier in TABLE 2.)

(3) Adjust the SET CARRIER control to bring the meter pointer to the SET R.F. mark.

(4) Couple the external modulation source to the EXT MOD and E terminals.

(5) With the METER READS key switch held to F.M., adjust the SET MOD control until the required deviation is indicated on the panel meter; read the meter on its middle scale when the DEVIATION RANGE switch is set to 5 kc/s, and read on the lower scale when the switch is set to 15 kc/s. If the DEVIATION - NORMAL/HIGH switch is set to HIGH, the meter readings must be multiplied by the appropriate factor given in TABLE 2.

For any settings of the DEVIATION RANGE and DEVIATION - NORMAL/HIGH switches, and within the modulation frequency range 50 c/s to 15 kc/s, approximately 25 volts r.m.s. is required between the EXT MOD and E terminals for full deviation. With respect to 1 kc/s, the frequency characteristic of the modulation system is flat to within ±1 dB from 50 c/s to 15 kc/s.

2.5.4 Simultaneous Frequency and Amplitude Modulation

(1) Set up the required depth of amplitude modulation as detailed in Section 2.5.2.(a).

(2) Leaving the MOD SELECTOR switch at INT MOD - A.M., and without altering the setting of the SET MOD control, set up the required deviation in a similar manner to that detailed in Section 2.5.3(b); in this case, adjust the amount of deviation by variation of the audio input from the external modulation source.

2.6 R.F. OUTPUT ARRANGEMENTS

Five factors affect the output level from the Signal Generator; these factors are:

(a) The SET CARRIER control whose setting determines the input level to the attenuator cascade.

(b) The "coarse" or OUTPUT VOLTAGE attenuator.

(c) The "fine" or MULTIPLY BY attenuator.

2.6. (continued)

(d) The TERMINATING UNIT which plugs on the end of the output cable from the fine attenuator.

(e) ATTENUATOR PAD Type TM 5552, which is an optional accessory designed for insertion between the output cable and TERMINATING UNIT when especially low output levels are required.

The SET CARRIER control is adjusted in conjunction with the panel meter; with the METER READS key switch in its central position, the panel meter forms part of a crystal voltmeter which monitors the input to the coarse attenuator. The panel meter has three main marks on its scale; these marks are -1 dB, SET R.F., and +1 dB respectively. Normally, the SET CARRIER control should be adjusted to bring the meter pointer to the SET R.F. mark.

Four 20-dB steps give the coarse or OUTPUT VOLTAGE attenuator a total range of 80 dB; each setting of the attenuator control has markings in red * and in white. The red markings are in terms of decibels relative to 1 μV; the white markings are directly in units of voltage.

The 2-dB steps given the fine or MULTIPLY BY attenuator a total range of 20 dB; each setting of the attenuator control has markings in red and white, the red markings being in terms of decibels relative to 1 μV, and the while markings, multiplying factors for the white voltage markings on the coarse attenuator.

Both attenuators have a characteristic impedance of 75 ohms and, "look ing into" the coaxial plug at the end of the output cable, the instrument appears as a generator with a source impedance of 75 ohms.

The TERMINATING UNIT is, essentially, a 6-dB attenuator pad; "looking into" its input socket (with the output sockets unterminated) the unit presents an impedance of 75 ohms, while the two outlets provide alternative output impedances of 52 and 75 ohms respectively.

The ATTENUATOR PAD has a characteristic impedance of 75 ohms and provides an optional, additional, 20-dB attenuator of the output signal.

It should be noted particulary that the r.f. output controls on the Signal Generator are calibrated in terms of source e.m.f or open-circuit output voltage. The significance of quoting the output of a signal generator in this way will be apparent when it is remembered that one of the primary functions of a signal generator is to simulate a received signal as it would come from an aerial.

To take a simple case - that in which a 75-ohm receiver is fed from a 75-ohm dipole, the e.m.f. induced in the aerial is shared between its inherent 75-ohm radiation resistance and the matched 75-ohm receiver input.

* Yellow on later models.

2.6 (continued)

Clearly, when the same receiver is fed from a signal generator, the corresponding signal strength is given by the source e.m.f. of the signal generator, and not by the on-load p.d. at the receiver terminals.

2.6.1 Outputs from 1 μV to 100 mV at 52 and 75 ohms

It is intended that the Signal Generator should normally be used with the SET CARRIER control adjusted to bring the meter pointer to the SET R.F. mark; with the TERMINATING UNIT coupled directly to the output cable; and, without the ATTENUATOR PAD Type TM 5552.

Used in this way, the Signal Generator should be regarded as a source of zero impedance in series with a resistance of either 75 ohms or 52 ohms, the open-circuit output level, or source e.m.f., being variable in 2-dB steps from 1 μV to 100 mV and being given

(a) directly in terms of decibels relative to 1 μV, by the sum of the "red" settings of the OUTPUT VOLTAGE and MULTIPLY BY attenuators;

(b) directly in voltage, by the product of the "white" settings of the OUTPUT VOLTATE and MULTIPLY BY attenuators

The -1 dB and +1 dB marks on the panel meter allow interpolation between the 2-dB steps of the MULTIPLY BY attenuator. Setting the meter pointer to either the +1 dB or -1 dB mark increases or decreases the input to the attenuator cascade by 1 decibel. Thus, using the SET CARRIER control and panel meter in conjunction with the OUTPUT VOLTAGE and MULTIPLY BY attenuators, the output level from the Signal Generator can be varied in 1-dB steps over the range 0 to +100 dB relative to 1 μV.

It should be noted that the "white" voltage indication given by the attenuator controls is not directly applicable when the meter is set to other than the SET R.F. mark; with the meter at -1 dB, the source e.m.f. at the TERMINATING UNIT outlets is 0.89 of the indicated voltage; with the meter at +1 dB, the source e.m.f. is 1.12 of the indicated voltage.

2.6.2 Outputs from 2 μV to 200 mV at 75 ohms only

With the TERMINATING UNIT detached and with the meter at the SET R.F. mark, th output level obtained directly from the plug at the end of the r.f. output cable is variable in the range 2 μV to 200 mV and is derived via a source impedance of 75 ohms.

Under these conditions, the open-circuit level, or source e.m.f., in terms of decibels relative to 1 μV is obtained by adding 6 dB to the sum of the meter reading and the "red" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators; the source e.m.f. is given directly in voltage

2.6.2 (continued)

by doubling the product of the "white" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators.

2.6.3 Outputs from 0.1 μV to 10 mV at 52 and 75 ohms

With the TERMINATING UNIT coupled to the r.f. output cable via the optional 20-dB ATTENUATOR PAD and with the meter at the SET R.F. mark, the output level from the TERMINATING UNIT is variable in the range 0.1 μV (nominal) to 10 mV.

In this case, the source e.m.f. in terms of decibels relative to 1 μV is obtained by subtracting 20 dB from the sum of the meter reading and the "red" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators; the source e.m.f. is given directly in voltage by dividing the product of the "white" indications of the OUTPUT VOLTAGE and MULTIPLY BY attenuators by 10.

2.6.4 Output in terms of voltage developed across an external load

For some particular applications, it may be desired to work not in terms of source e.m.f. as indicated by the meter and attenuator controls, but in terms of actual voltage developed across the external load. This on-load, or terminal voltage, is given by the expression

$$V_L = E \times \frac{Z_L}{Z_0 + Z_L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where V_L = actual voltage developed across the external load.

E = the source e.m.f. of the Signal Generator.

Z_L = the impedance of the external load.

Z_0 = the source impedance of the Signal Generator; (with the TERMINATING UNIT in use, Z_0 = 75 or 52 Ω; with the TERMINATING UNIT removed, Z_0 = 75 Ω).

The expression is based on the assumption that the external load impedance Z_L is essentially resistive. Where Z_L is not essentially resistive, it may be necessary for the user to revise the expression to take account of the reactive component of the load.

A series of multiplying factors, which can be used to convert from source e.m.f. to actual voltage developed across an external resistive load, and which have been derived with the aid of the above expression, are given in TABLE 3 for a selection of typical load values.

2.6.4 (continued)

TABLE 3

External load impedance in ohms	Approximate multiplying factor to convert from source e.m.f. to actual voltage developed across an external resistive load	
	Z_0 = 75 Ω	Z_0 = 52 Ω
10	0.12	0.16
20	0.21	0.28
30	0.29	0.36
40	0.35	0.43
50	0.4	0.49
52	0.41	0.5
60	0.44	0.53
70	0.48	0.57
75	0.5	0.59
80	0.51	0.61
100	0.57	0.65
150	0.67	0.74
200	0.73	0.79
300	0.8	0.85
500	0.87	0.9
600	0.89	0.92

2.7 SYNCHRONIZING SIGNAL

An audio sinewave signal, derived from the internal a.f. oscillator, is available between the SYNC and E terminals of the instrument when the MOD SELECTOR switch is set at either of the INT MOD positions. The frequency of the signal will depend on the setting of the SET MOD. FREQ. switch; it has an open-circuit level which varies from about 30 volts at 400 c/s to about 100 volts at 1500 c/s, and is derived via a source impedance of approximately 250 kΩ.

When an output from the equipment under test is being viewed on a cathode-ray oscilloscope, it will often be found convenient to lock the c.r.o. time base directly with the SYNC signal rather than with the actual signal being viewed.

The SYNC output can, of course, also be used when an audio frequency signal is required for the equipment under test.

3 TECHNICAL DESCRIPTION

3.1 R.F. CIRCUITS

The output from the oscillator V3 is variable only over the fundamental frequency range of 4.5 to 9.16 Mc/s; the frequency bands of 13.5 to 27.5 Mc/s, 27 to 55 Mc/s, 54 to 110 Mc/s, and 108 to 220 Mc/s are obtained from the outputs of four ganged harmonic multipliers of x3 (V6), x2 (V8), x2 (V10), and x2 (V12) respectively. The setting of the frequency RANGE switch determines which of these multipliers acts as the output stage.

Output over the 1.5- to 13.5-Mc/s band is obtained by applying the 27- to 55-Mc/s output of the second multiplier valve V8 to the double triode valve V7. The section V7a functions as a combined mixer and 30-Mc/s oscillator, and section V7b, as an amplifier and low-pass filter. The variable frequency output from the second multiplier is thus heterodyned with the fixed 30-Mc/s signal to produce outputs between 1.5 and 13.5 Mc/s.

The main tuning dial which operates the ganged components R7, C34, C46, C65, C75, and C81, has five scales which are all direct-reading in output frequency. Four of these scales are for the bands extending upwards in frequency from 13.5 Mc/s, and the fifth scale which covers the 1.5 to 13.5-Mc/s band, is calibrated directly in terms of the difference between 30 Mc/s and the output frequency of the multiplier, e.g. 1.5 to 13.5 Mc/s corresponds to the second multiplier being tuned from 31.5 to 43.5 Mc/s.

No matter which r.f. band is in use, the ultimate output is derived via two resistive 75-ohm ladder network attenuators in cascade. The first attenuator - the COARSE control - has a range of 80 dB and is variable in 20-dB steps; the second attenuator - the FINE control - has a range of 20 dB in 2-dB steps. The input to the cascade is adjustable by means of the SET R.F. control, R44, and is monitored by the meter M1. The meter has a SET R.F. mark on its scale; plus and minus 1-dB marks above and below the SET R.F. mark allow interpolation between the 2-dB steps of the FINE attenuator. The output from the fine attenuator is applied to a coaxial output cable which is permanently attached to the Signal Generator. The direct open-circuit output obtainable from this cable, at a source impedance of 75 ohms, is variable between 2 μV and 200 mV.

By using the plug-in Terminating Unit supplied with the instrument, outputs within the range 1 μV to 100 mV are obtainable at source impedances of 52 and 75 ohms; with the optional Attenuator Pad interposed between the output cable and the terminating Unit, outputs down to 0.1 μV are available.

The built-in crystal calibrator V4, uses a crystal unit having a fundamental frequency of 333.3 kc/s. This is coupled to the variable frequency r.f. oscillator via C33, to provide fourteen check points on each of the four upper frequency bands covered by the Signal Generator. The h.t. supply to the calibrator is automically switched on by the insertion of a telephone plug into the CRYSTAL CHECK jack on the front panel; the heterodyne

3.1 (continued)

beats at the checking points may then be heard in the head telephones or via the receiver under test. The cursor of the tuning dial is adjustable so that it may be set to correspond exactly to the nearest crystal checking point.

To facilitate tuning, a slow-motion worm-and-wheel drive is incorporated; this control is fitted with a dial marked linearly fro 0 to 100 to assist the operator in sub-dividing the frequency scales of the main tuning dial. In addition, there is a fine-tuning control. The fine tuning is achieved by varying the reactor screen-supply voltage by means of R162. The frequency coverage on the top band (108 to 220 Mc/s), is approximately 24 kc/s, and proportionately less on the lower frequency bands.

The two INC. FREQ. controls consist of switch S10 and its associated fixed resistors (COARSE CONTROL), and variable resistor R112 (FINE control). Above 55 Mc/s carrier frequency, these controls are direct reading and have a total coverage of ±55 kc/s. Below 54 Mc/s, the calibration of the incremental frequency controls is subject to a multiplying factor which is engraved on the front panel adjacent to each setting of the RANGE switch.

For the application of the incremental carrier shift and for frequency modulation, a reactor valve, V6, is included in the tuned circuit of the r.f. oscillator. Movement of the incremental-frequency controls varies the d.c. bias applied to the grid of the valve, causing a change in its mutual conductance and thus a change in the oscillator frequency, Both the a.f. modulating signal and the d.c. shift voltage are applied to the grid of the valve via a tracking potentiometer, R7, ganged to the main tuning capacitor, so that the deviation or carrier shift is kept constant as the Signal Generator is tuned over any one band.

A CARRIER on/off switch, S11, is included to enable the r.f. signal to be interrrupted without the output circuits of the generator being affected in any way. This is done by switching the h.t. supply to the screen of one of the harmonic multipliers; the multiplier selected depends on the setting of the RANGE switch.

3.2 MODULATION SYSTEMS

Either internal or external a.f. modulation (f.m. or a.m.) may be applied; the SET MOD. FREQ. switch, S12, brings into circuit the appropriate tuning capacitor to give 400, 1000, or 1500 c/s modulation as required. For frequency modulation the a.f. signal passes through V5, switched as a cathode follower, and is applied to the reactor-valve input via the switched potentiometer network at S2ba and S2ca (part of the RANGE switch), and the tracking potentiometer R7. By means, the ratio of the a.f. input voltage to f.m. deviation is maintained constant at all frequencies on each band, and is independent of the setting of either the RANGE switch or the TUNE controls.

4 MAINTENANCE

4.1 ACCESS TO COMPONENTS

The valves, crystal and semiconductors may normally be replaced without special selection. Valves V1, V5, V9, V11, and V13 to V15 are immediately accessible on removing the instrument from its case. To gain access to the 333.3 kc/s oscillator crystal, X1, and to the remaining valves, remove the R.F. Unit screening cover. The silicon diode X2, forms part of the coarse attenuator assembly and can be removed as described in Section 4.1.3.

4.1.1 Removal from Case

To remove the instrument from its case:

(1) Remove the screw securing the small plate in the left-hand pocket. Removal of this plate will free the mains lead.

(2) Extract the eight screws from around the edge of the front panel: then pull the instrument clear of its case.

(3) Disconnect the interconnecting cable from the power unit chassis: free the r.f. cable by removing the plate which secures it to the rear of the right-hand pocket.

(4) After removing the seven screws from the underside of the case, lift out the power unit.

4.1.2 Removal of R.F. Unit Cover

To remove the screening cover from the r.f. unit:

(1) With the instrument out of its case, lay it on its face.

(2) Extract the two screws which secure the screening cover of the r.f. unit in position.

(3) Grip the sides of the screening cover and draw if off; the cover is held by earthing contact springs and will consequently offer some resistance to removal.

4.1.3 Removal of Monitor Diode (X2) Cover

In addition to the actual attenuator components, the r.f. monitor diode, X2, and its associated filter components are mounted within the OUTPUT VOLTAGE attenuator casing. Access to the diode, X2, resistors R71 and R72, and capacitors C88, C89 and C90 can be obtained by removing the cover of the attenuator in the following manner:-

(1) Disconnect R70 from the stand-off pillar projecting through the cover of the attenuator.

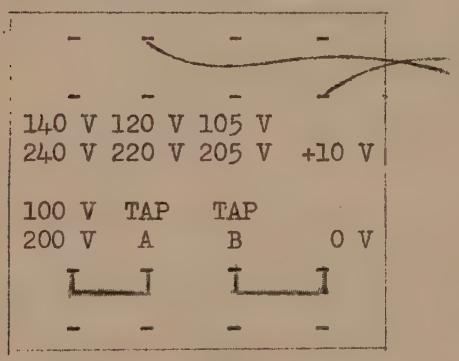
4.1.3 (continued)

(2) Remove the central securing screw and lift the screening cover clear of the attenuator body.

4.2 MAINS INPUT CONNECTIONS

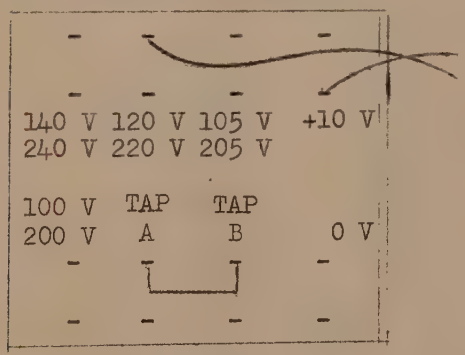
The instrument is fitted with a mains transformer which has a double-would primary. The two sections may be connected either in series-parallel or in series, depending upon whether the instrument is to be used for 100- to 150-volt, or 200- to 250-volt operation. Each primary section is tapped so that intermediate voltages within the ranges can be accommodated.

100- to 150-volt Operation



The primary windings are connected in a series-parallel arrangement by linking TAP A to the tag marked '100 V/200 V', and TAP B to the tag marked '0 V'. The fly-leads are connected to the tags whose voltage annotations add up to the value of the supply voltage. One fly-lead must always be connected to tag '0 V' or to tag '+10 V'. The sketch shows the transformer connected for 230-volt operation.

200- to 250-Volt Operation



The primary windings are connected in series by linking TAP A to TAP B. The fly-leads are connected to the tags whose voltage annotations add up to the value of the supply voltage. One fly-lead must always be connected to tag '0 V' or to tag '+10 V'. The sketch shows the transformer connected for 230-volt operation.

WORKING VOLTAGES

The voltages given in this Section, for guidance when servicing the instrument, were obtained from measurements made on a representative TF 995A/5; the voltmeter used had a resistance of 20,000 ohms per volt.

4.3.1 Power Supply Voltages

TABLE 1

Measured across:-	Volts a.c.
Primary winding of T4	240
H.T. secondary winding and chassis	260-0-260
Heater winding LTR	5
Heater winding LT	6.3
	Volts d.c.
Pin 1 on plug PL1 and chassis	260
Junction of R117/R118 and chassis	-85
Junction of L16/L17 and chassis	280
Cathode of V11 and chassis	295

4.3.2 Valve Electrode Voltages

When checking the instrument against the voltages given in TABLE 2, the MOD SELECTOR switch should be set to INT MOD - A.M., the RANGE switch (unless otherwise specified) should be set to 108 - 220 Mc/s, and the SET CARRIER and SET MOD controls should be turned to their maximum and minimum settings respectively.

TABLE 2

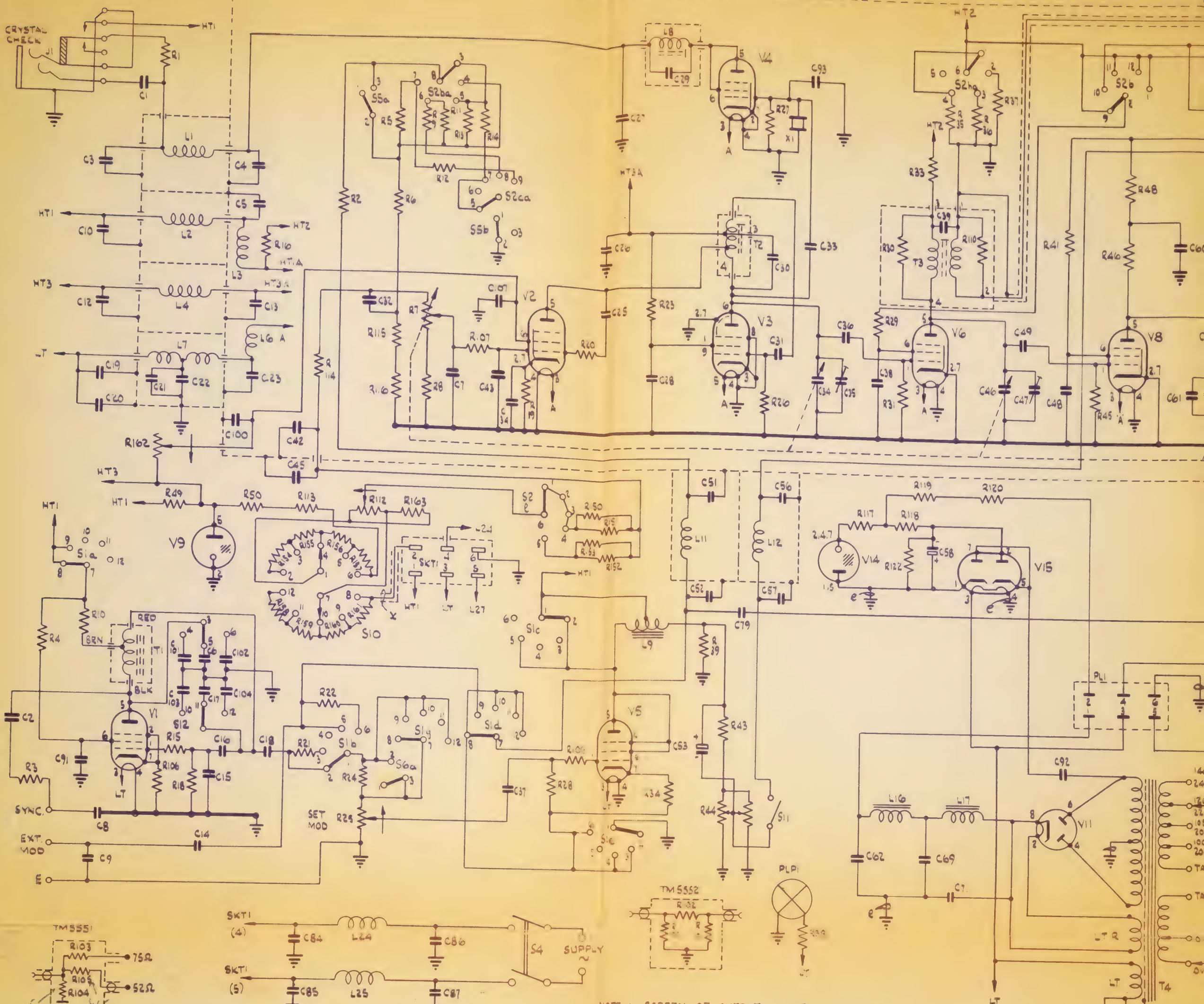
Valve No.	Va	Vg2	Vk
V1	245	50	1.5
V2	150	150	4.0
V3	150	75	
V4	55	55	
V5	250	250	3.6*
V6	125	160	
V7**	Pin 1 235		
V7**	Pin 6 255		2.5
V8	105	145	
V9	150		
V10	145	145	
V11	Pin 6 or 4 260 a.c.		295
V12	150		
V13	Pin 1 260		Pin 3 110
V13	Pin 6 90		Pin 8 16

4.3.2. (continued)

All voltages shown are d.c. with respect to the chassis, except for V11 anodes.

*The cathode potential of V5 will increase to 45 volts when the MOD SELECTOR switch is set to INT MOD F.M.

**When checking the voltages for V7, set the RANGE switch to 1.5 - 13.5 Mc/s.



LEADS MARKED δ TO BE WIRED IN TC20700/6 WIRE AND CONNECTED TO A COMMON EARTH AT PIN 6 PL1

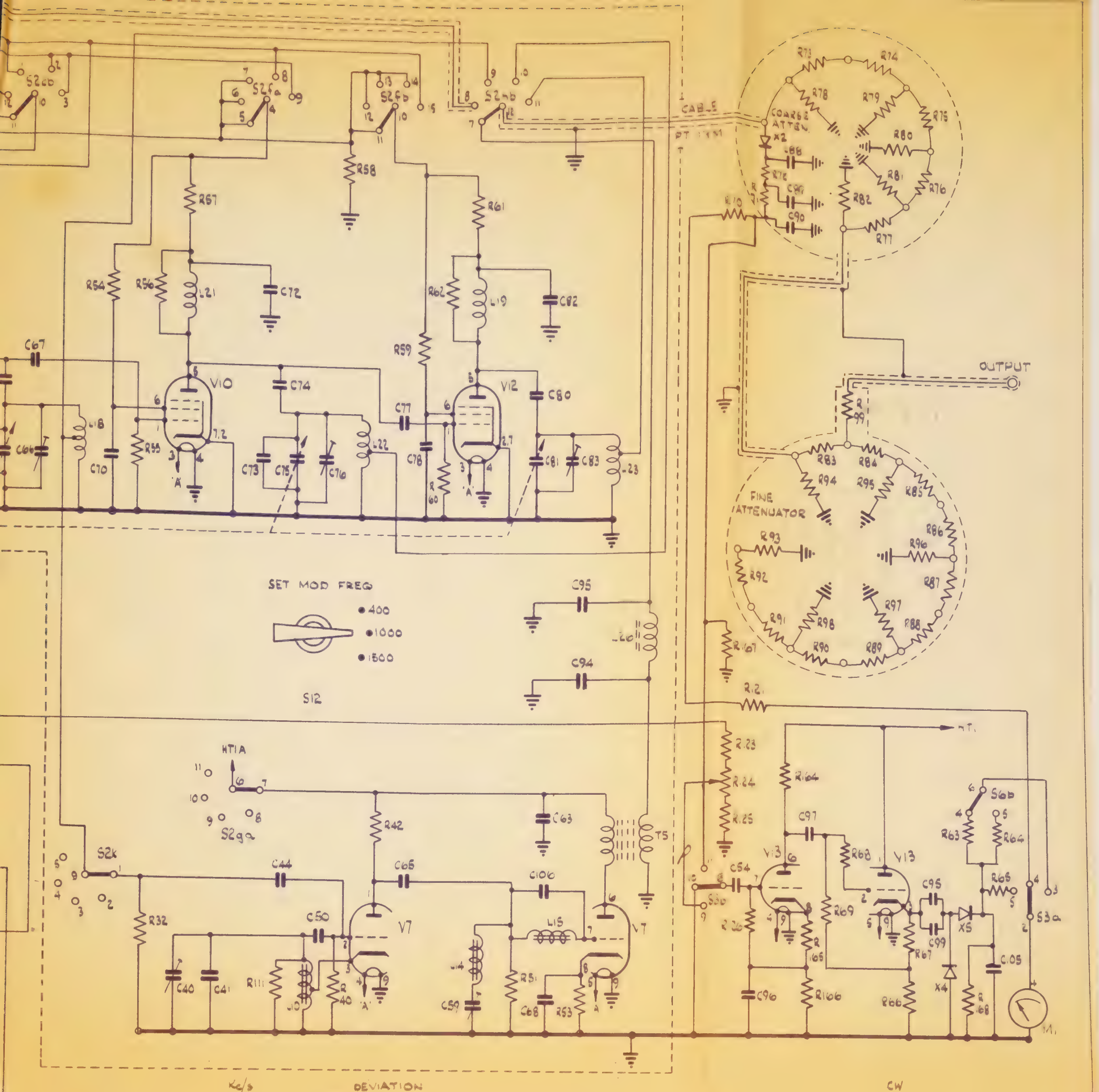
NOTE :- SCREEN OF OUTPUT CABLE OF R.F. BOX TO BE EARTHED TO TUNING CONDENSER FRAME

δ^{x} - SCREENED FLEXIBLE CABLE MINIATURE TYPE IC TO SPEC. DEF. 10

LEADS MARKED BE SCREENED & CABLE FORM

RESISTORS			S.L. REF.	R37	5kΩ ±5% 7W	110/TM4826/5	R74	742Ω ±1% ⅛W	38/TM4297A	R111	10kΩ ±10% ¼W	57/TM4826/5
470kΩ ±10% ¼W	4/TM4800/2	R38	10Ω ±10% ½W	67/TF995A/5	R75	742Ω ±1% ⅛W	35/TM4297A	R112	20kΩ VAR ±10% 2W	81/TF995A/5
5kΩ NOM. S.I.C. ½W	58/TM4826/5	R39	47kΩ NOM. A.I.C. 10W	110/TF995A/5	R76	742Ω ±1% ⅛W	35/TM4297A	R113	68kΩ ±10% ½W	23/TM4800/2
20kΩ ±10% ½W	18/TM4800/2	R40	15kΩ ±10% ¼W	64/TM4826/5	R77	742Ω ±1% ⅛W	35/TM4297A	R114	100kΩ S.I.C. ½W	145/TM4826/5
470kΩ ±10% ¼W	5/TM4800/2	R41	6.8kΩ ±10% ¼W	65/TM4826/5	R78	220Ω ±1% ⅛W	38/TM4297A	R115	1kΩ ±10% ¼W	147/TM4826/5
7kΩ NOM. S.I.C. ¼W	5/TM4706	R42	2.2kΩ ±10% ¼W	66/TM4826/5	R79	91.6Ω ±1% ⅛W	37/TM4297A	R116	330Ω NOM. S.I.C. ¼W	60/TM4826/5
2kΩ NOM. S.I.C. ½W	59/TM4826/5	R43	10kΩ ±10% 1W	61/TF995A/5	R80	91.6Ω ±1% ⅛W	37/TM4297A	R117	2.2kΩ ±10% ¼W	56/TM4299/2
0kΩ VAR ±10% 2W W.W.	18/TM4831/5	R44	200kΩ + 200kΩ VAR	75/TF995A/5	R81	91.6Ω ±1% ⅛W	37/TM4297A	R118	22kΩ ±10% ¼W	43/TM4299/2
7kΩ S.I.C. ½W	146/TM4826/5	R45	68kΩ ±10% ¼W	61/TM4826/5	R82	82.5Ω ±1% ⅛W	36/TM4297A	R119	68kΩ S.I.C. ¼W	34/TM4299/2
1kΩ NOM. S.I.C. ½W	7/TM4706	R46	6.8kΩ ±10% ½W	109/TM4826/5	R83	7.9Ω ±1% ⅛W	24/TM4298	R120	33kΩ ±10% ¼W	35/TM4299/2
kΩ ±10% ½W	6/TM4800/2	R47			R84	17.9Ω ±1% ⅛W	24/TM4298	R121	950Ω ±10% WW	83/TF995A/5
kΩ NOM. S.I.C. ¼W	4/TM4706	R48	2.2kΩ ±10% ¼W	66/TM4826/5	R85	17.9Ω ±1% ⅛W	24/TM4298	R122	35kΩ ±10% ½W	44/TM4299/2
7kΩ NOM. S.I.C. ½W	8/TM4706	R49	4kΩ ±5% 7W	72/TF995A/5	R86	17.9Ω ±1% ⅛W	24/TM4298	R123	100kΩ ±10% ¼W	133/TF995A/5
9kΩ NOM. S.I.C. ¼W	3/TM4706	R50	100kΩ S.I.C. ½W	22/TM4800/5	R87	17.9Ω ±1% ⅛W	24/TM4298	R124	5kΩ VAR. W.W.	134/TF995A/5
2kΩ NOM. S.I.C. ½W	6/TM4706	R51	4.7kΩ ±10% ¼W	55/TM4826/5	R88	17.9Ω ±1% ⅛W	24/TM4298	R125	2.2kΩ ±10% ¼W	135/TF995A/5
kΩ ±10% ¼W	8/TM4800/2	R52			R89	17.9Ω ±1% ⅛W	24/TM4298	R126	1MΩ ±10% ¼W	59/TF995A/5
kΩ ±5% 7W	113/TM4826/5	R53	270Ω ±10% ¼W	54/TM4826/5	R90	17.9Ω ±1% ⅛W	24/TM4298			
		R54	6.8kΩ ±10% ¼W	65/TM4826/5	R91	17.9Ω ±1% ⅛W	24/TM4298			
0kΩ ±10% ¼W	7/TM4800/2	R55	68kΩ ±10% ½W	115/TM4826/5	R92	17.9Ω ±1% ⅛W	24/TM4298	R150	560kΩ S.I.C. ½W	14A/TM4943BR
kΩ NOM. S.I.C. ¼W	53/TM4826/5	R56	47kΩ ±10% ½W PART OF L21	122A/TM4826/5	R93	61.2Ω ±1% ⅛W	28/TM4298	R151	120kΩ ±2% ½W	14/TM4943BR
Ω ±5% ¼W	62/TM4826/5	R57	2.2kΩ ±10% ½W	66/TM4826/5	R94	332Ω ±1% ⅛W	26/TM4298	R152	430kΩ ±2% ½W	12/TM4943BR
kΩ ±10% ¼W	66/TF995A/5	R58	100kΩ ±10% ¼W	68/TM4826/5	R95	167Ω ±1% ⅛W	27/TM4298	R153	8.3MΩ S.I.C. ¼W	12A/TM4943BR
kΩ ±10% ¼W	66/TF995A/5	R59	6.8kΩ ±10% ¼W	65/TM4826/5	R96	167Ω ±1% ⅛W	27/TM4298	R154	10kΩ ±1% ¼W	121/TF995A/5
kΩ ±10% ¼W	63/TM4826/5	R60	100kΩ ±10% ¼W	50/TM4826/5	R97	167Ω ±1% ⅛W	27/TM4298	R155	10kΩ ±1% ¼W	121/TF995A/5
Ω NOM. S.I.C. ¼W	65/TF995A/5	R61	2.2kΩ ±10% ¼W	66/TM4826/5	R98	167Ω ±1% ⅛W	27/TM4298	R156	10kΩ ±1% ¼W	121/TF995A/5
Ω VAR	74/TF995A/5	R62	33kΩ ±10% ½W PART OF L19	140A/TM4826/5	R99	37.5Ω ±1% ⅛W	25/TM4298	R157	10kΩ ±1% ¼W	121/TF995A/5
Ω ±10% ¼W	64/TM4826/5	R63	39kΩ ±10% S.I.C. ¼W	78/TF995A/5	R100	90Ω ±2% ⅛W	16/TM5552	R158	10kΩ ±1% ¼W	121/TF995A/5
MΩ ±10% ¼W	52/TM4826/5	R64	120kΩ ±10% S.I.C. ¼W	58/TF995A/5	R101	90Ω ±2% ⅛W	16/TM5552	R159	10kΩ ±1% ¼W	121/TF995A/5
kΩ ±10% ¼W	10/TM4800/2	R65	33kΩ NOM. S.I.C. ¼W	73/TF995A/5	R102	360Ω ±1% ⅛W	17/TM5552	R160	10kΩ ±1% ¼W	121/TF995A/5
kΩ ±10% ¼W	65/TM4826/5	R66	33kΩ ±10% ¼W	64/TF995A/5	R103	37.5Ω ±5% ⅛W	10/TM5551	R161	10kΩ ±1% ¼W	121/TF995A/5
kΩ ±10% ¼W	9/TM3900/52	R67	470Ω ±10% ¼W	63/TF995A/5	R104	75Ω ±5% ⅛W	11/TM5551	R162	25kΩ VAR. 3W	116/TF995A/5
kΩ ±10% ¼W	5/TM4826/5	R68	4.7kΩ ±10% ¼W	62/TF995A/5	R105	14.5Ω ±5% ⅛W	12/TM5551	R163	56kΩ S.I.C. ¼W	122/TF995A/5
±10% ¼W	108/TM4826/6	R69	1MΩ ±10% ¼W	59/TF995A/5	R106	560Ω ±10% ¼W	77/TF995A/5	R164	100kΩ ±10% ¼W	137/TF995A/5
Ω ±10% ¼W	66/TM4826/5	R70	2.7kΩ NOM. S.I.C. ¼W	71/TF995A/5	R107	22kΩ ±10% ¼W	69/TM4826/5	R165	470Ω ±10% ½W	63/TF995A/5
Ω ±5% ½W	11/TM4800/2	R71	1kΩ ±20% ⅛W	39/TM4297A	R108			R166	10kΩ ±10% ¼W	136/TF995A/5
±5% 7W	112/TM4826/5	R72	1kΩ ±20% ⅛W	39/TM4297A	R109	2.2kΩ ±10% ¼W	69/TF995A/5	R167	10kΩ HIGH STAB. ¼W	138/TF995A/5
	111/TM4826/6	R73	82.5Ω ±1% ⅛W	24/TM4297A	R110	100Ω ±10% ¼W	69/TM4826/5	R168	1MΩ ±10% ¼W	59/TF995A/5

CAPACITORS					C28	0.01μF	±20%	350V	3/TM4800/2
C1	0.1μF	±20%	350V	3/TM4800/2	C29	47pF	±20%	350V	17/TM4800/2
C2	0.1μF	±20%	350V	17/TM4800/2	C30	10pF	S.I.C.	500V	2/TM4826/5
C3	100pF	NOM	PART OF ASSY.	2/TM4826/5	C31	100pF	±5%	500V	117/TM4826/5
C4	100pF	±10%	350V	117/TM4826/5	C32	2μF	±25%	150V	117/TM4826/5
C5	100pF	±10%	350V	117/TM4826/5	C33	1pF	±20%	500V	2/TM4800
C6	0.02μF	±20%	350V	2/TM4800	C34	14pF - 200pF			71/TM4826/5
C7	220pF	±20%	500V	71/TM4826/5	C35	3-30pF	TRIMMER		96/TF995A/5
C8	100pF	±10%	350V	96/TF995A/5	C36	47pF	±20%	500V	86/TF995A/5
C9	100pF	±20%	350V	86/TF995A/5	C37	0.1μF	±20%	350V	2/TM4826/5
C10	100pF	NOM	PART OF ASSY.	2/TM4826/5	C38	100pF	-0% +100%	500V	
C11					C39	0.01μF	±20%	350V	17/TM4800/2
C12	100pF	NOM.	PART OF ASSY.	2/TM4826/5	C40	10pF	TRIMMER		
C13	100pF	±10%	350V	117/TM4826/5	C41	3.3pF	±10%	500V	
C14	2μF	±25%	250V	87/TM4800/2	C42	4700pF	-0% +100%	500V	
C15	0.01μF	±20%	400V	13/TM4800/2	C43	5pF	±20%	750V	
C16	0.01μF	±25%	400V	15/TM4800/2	C44	10pF	±10%	500V	
C17	0.1μF	±20%	350V	14/TM4800/2	C45	0.5μF	±25%	150V	
C18	0.1μF	±20%	350V	16/TM4800/2	C46	7-100pF	VAR.		
C19	100pF	NOM	PART OF ASSY.	3/TM4826/5	C47	2-8pF	TRIMMER		
C20	10,000pF	±20%		135/TM4826/5	C48	100pF	-0% +100%	500V	
C21	1000pF	±20%		12/TM3900/75	C49	22pF	±20%	500V	
C22	100pF	NOM	PART OF ASSY.	9/TM3900/75	C50	47pF	±20%	500V	
C23	100pF	±10%	350V	86/TM4826/5	C51	100pF	±10%	350V	
C24	0.001	±20%	600V	91/TM4826/5	C52	100pF	NOM.	PART OF ASSY.	
C25	39pF	±5%	750V	85/TM4826/5	C53	8μF	ELECT	350V	
C26	0.1μF	±20%	350V	78/TM4826/5	C54	0.1μF	±25%	250V	
C27	1000pF	±20%	600V	91/TM4826/5	C55	33pF	±20%	500V	
					C56	100pF	±10%	350V	
					C57	100pF	NOM.	PART OF ASSY.	
					C58	8μF	-50% +20%	450V	
					C59	10pF	TRIMMER		
					C60	820pF	±20%		
					C61	5pF	±20%	500V	
					C62	30μF	-50% +20%	35V	
					C63	0.01μF	±20%	35V	

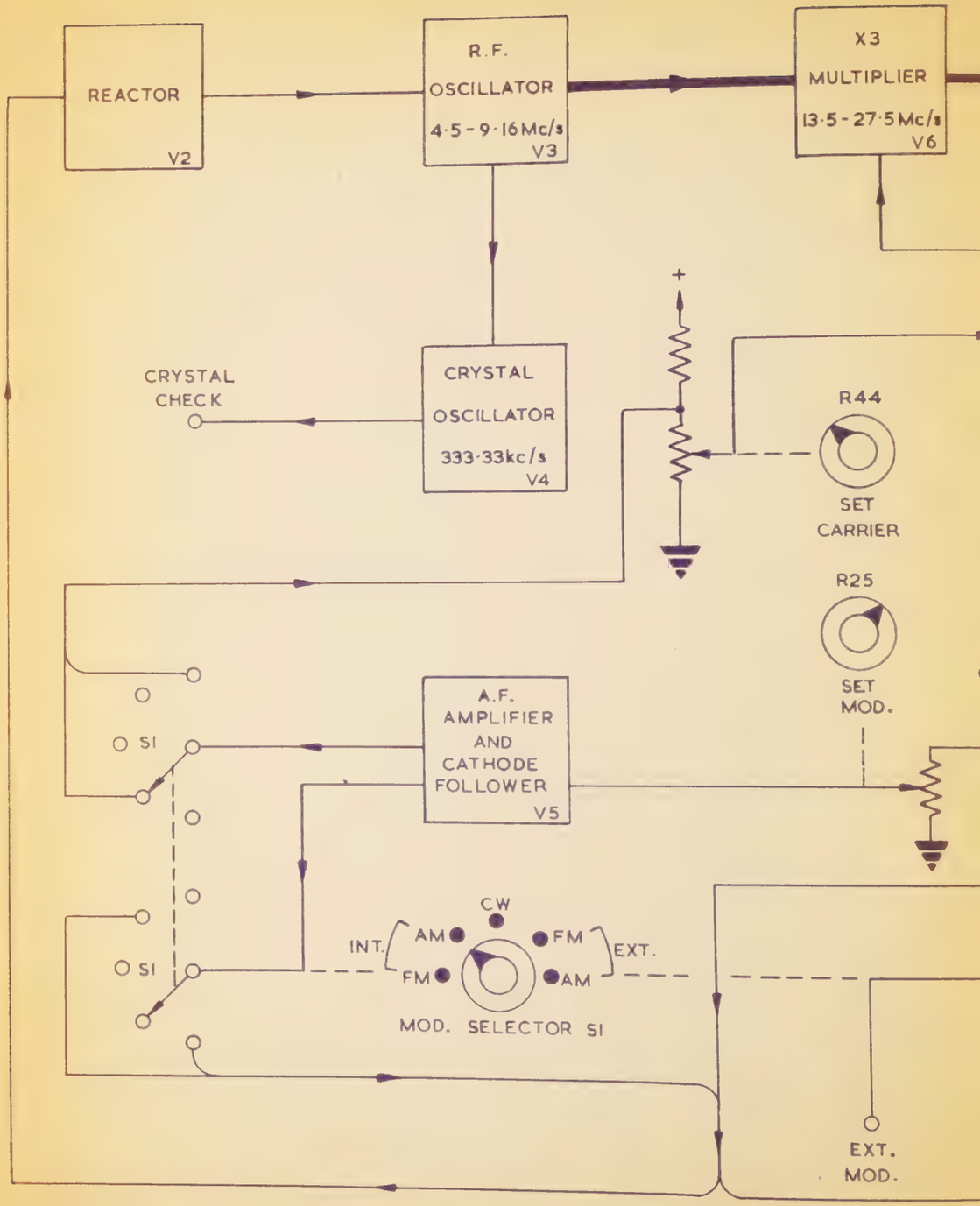


3 TM4826/5	C65	7-100 pF	VAR		16 TM4831/2	C102	·01 μF	S.I.C.	400V	9 TM4943 AP	L4	H.T. FILTER	2 TM4826/5	S12	SET MOD FREQ.	18 TF995A 5
TM3900/74	C66	2-8 pF	TRIMMER		15 TM4831/2	C103	·25 μF	±25%	400V	10 TM4943 AP	L5					
9 TM4826/5	C67	22 pF	±20%	500V	87 TM4826/5	C104	·05 μF	±25%	350V	11 TM4943 AP	L6	FILTER CHOKE	1 TM3900/75			
8 TM4826/5	C68	·01 μF	±20%	350V	83 TM4826/5	C105	2 μF	±25%	150V	7 TM4943/88	L7	LT FILTER	3 TM4826/5			
1 TM4826/5	C69	16 μF	+50% -20%	350V	12 TM4299/2	C106	3·3 pF	±10%	500V	75 TM4826/5	L8	ANODE COIL	6 TM4826/5		TRANSFORMERS	
2 TM4826/5	C70	100 pF	+100% -0	500V	84 TM4826/5	C107	·1 μF		350V	78 TM4826/5	L9	CHOKE	11 TF995A/5	T1	L.F. OSC.	9 TF995A/5
TM4831/2	C71	8 μF	+50% -20%	350V	12 TM4299/2						L10	FIXED OSC COIL	42 TM4826/5	T2	MASTER OSC. TRANS.	7 TM4826/5
TM4831/2	C72	820 pF	±20%		79 TM4826/5						L11	H.F. FILTER	4 TM4826/5	T3	1ST HARMONIC MULT.	8 TM4826/5
6 TM4826/5	C73	5 pF	±20%	500V	118 TM4826/5						L12	H.F. FILTER	4 TM4826/5	T4	MAINS TRANS.	1 TM4299/2
TM4800/2	C74	100 pF	±10%	500V	81 TM4826/5						L13			T5	I.F. OUT TRANS.	93 TM4826/5
TM4826/5	C75	7-100 pF	VAR.		15 TM4831/2						L14	FILTER COIL	43 TM4826/5			
TM3900/52	C76	2-8 pF	TRIMMER		15 TM4831/2						L16	GRID CHOKE	44 TM4826/5			
0 TM4826/5	C77	10 pF	±20%	500V	80 TM4826/5						L16	SMOOTHING CHOKE	2 TM4299/2		CRYSTALS	
TM4826/5	C78	100 pF	+100% -0	500V	84 TM4826/5						L17	SMOOTHING CHOKE	2 TM4299/2	X1	MASTER CRYSTAL	102 TM4826/5
TM4826/5	C79	6 μF	±20%	150V	79 TF995A/5		VALVES				L18	COIL	9 TM4826/5	X2	CRYSTAL RECTIFIER	44 TM4297A
TM4826/5	C80	100 pF	±10%	500V	81 TM4826/5	V1	6AK6			47 TF995A/5	L19	COIL	140 TM4826/5	X3	CV425	7A TM4943/82
TM4826/5	C81	7-75 pF	VAR.		15 TM4831/2	V2	6AK5			101 TM4826/5	L20			X4	CV425	6A TM4943/82
TM4826/6	C82	820 pF	±20%		79 TM4826/5	V3	EF86			163 TM4826/5	L21	COIL	122 TM4826/5			
TM4831/2	C83	2-8 pF	TRIMMER		15 TM4831/2	V4	6AK5			101 TM4826/5	L22	FREQ. RANGE COIL	40 TM4826/5			
TM4831/2	C84	100 pF	±20%	300V A.C.	80 TF995A/5	V5	6AU6			49 TF995A/5	L23	FREQ. RANGE COIL	4 TM4826/5		MISCELLANEOUS	
TM4826/5	C86	100 pF	±20%	300V A.C.	80 TF995A/5	V6	6AK5			101 TM4826/5	L24	CHOKE	52 TF995A/5	PLP1	PILOT LAMP 6·5V ·3A	43 TF995A/5
TM4826/5	C86	100 pF	±20%	300V A.C.	80 TF995A/5	V7	12AT7			103 TM4826/5	L25	CHOKE	52 TF995A/5	M1	METER 0-100 μA	4 TF995A/5
TM4826/5	C87	100 pF	±20%	300V A.C.	80 TF995A/5	V8	6AK5			101 TM4826/5	L26	COIL	11 TM4826/5	J1	JACK 4117-A	54 TF995A/5
TM4826/5	C88	820 pF	±20%	350V	41 TM4297A	V9	DA2			48 TF995A/5				SKT1	SOCKET 6 WAY	55 TF995A/5
TM4826/5	C89	820 pF	±20%	350V	41 TM4297A	V10	6AK5			101 TM4826/5				PL1	PLUG 6 WAY	18 TM4299/2
TF995A/5	C90	820 pF	±20%	350V	41 TM4297A	V11	5Z4G			16 TM4299/2		SWITCHES				
TF995A/5	C91	0·1 μF	±20%	350V	19 TM4800/2	V12	6AK5			101 TM4826/5	S1	MOD. SELECT	53 TF995A/5			
TM4826/5	C92	0·25 μF	±20%	275V A.C.	32 TM4299/2	V13	12AT7			46 TF995A/5	S2	FREQ. RANGE M/C'S	95 TM4826/5			
TM4826/5	C93	15 pF	±20%	300V	119 TM4826/5	V14	5651			20 TM4299/2	S3	METER READS	35 TF995A/5			
TM4826/5	C94	120 pF	±10%	750V	74 TM4826/5	V15	6AL5			21 TM4299/2	S4	ON-OFF D.P.	36 TF995A/5			
TM4299/2	C95	68 pF	±10%	750V	90 TM4826/5						S5	NORMAL-HIGH F.M.	95 TM4826/5			
TM4826/5	C96	220 pF	±20%	500V	14 TF995A/5						S6	DEVIATION	34 TF995A/5			
TM4826/5	C97	·05	±20%	350V	142 TF995A/5											
TM4826/5	C98	2 μF	±25%	150V	5 TM4943/82		INDUCTANCE									
TM4299/2	C99	2 μF	±25%	150V	6 TM4943/82	L1	H.T. FILTER			2 TM4826/5						
TM4826/5	C100	4700 pF	+100% -0	500V D.C.	92 TM4826/5	L2	H.T. FILTER			2 TM4826/5	S10	INC. FREQ.	17 TF995A/5			
TM4826/5	C101	·25 μF	S.I.C.	400V	8 TM4943AP	L3	R.F. CHOKE			123 TM4826/5	S11	ON-OFF D.P.	36 TF995A/5			

TITLE :- CIRCUIT DIAGRAM FOR FM-AM SIGNAL GENERATOR WITH CALIBRATED INCREMENTAL TUNING

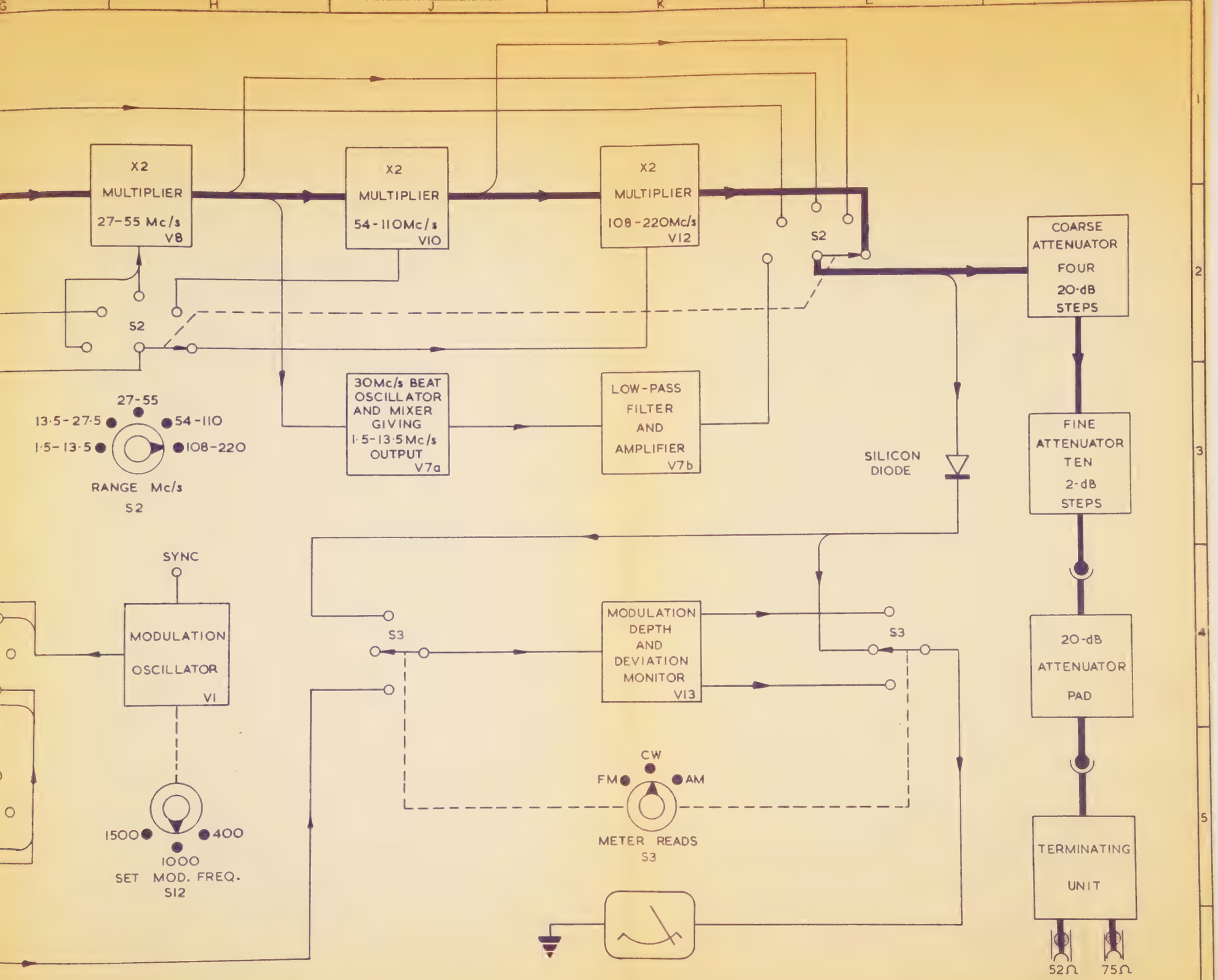
DRN. K.H. WILLIAMSON	ASSY. TE 23222/5
DATE 1-1-69	WIRING
CHKD. T. Wicks	S. LIST TF 995A/5
APPD. A.H.	DRG Nº TD23080/5
TRCD. E.M.T.	

MARCONI INSTRUMENTS LTD.



TITLE: BLOCK SCHEMATIC DIAGRAM OF SIGNAL GENERATOR TYPE TF995A/5							
DRAWN T. SIMKINS	DATE 4/60	CHKD.	APPD.	TRC'D. E.M.T.	ASSEMBLY	STOCK LIST TF995A/5	DRAWING NUMBER XD 32864
MARCONI INSTRUMENTS LTD.							SHEET 1 OF 1 SHEETS

BLOCK S



ATIC DIAGRAM OF SIGNAL GENERATOR TYPE TF995A/5

XD32864

DECIBEL CONVERSION TABLE

Ratio Down			Ratio Up	
VOLTAGE	POWER	DECIBELS	VOLTAGE	POWER
1·0	1·0	0	1·0	1·0
·9886	·9772	·1	1·012	1·023
·9772	·9550	·2	1·023	1·047
·9661	·9333	·3	1·035	1·072
·9550	·9120	·4	1·047	1·096
·9441	·8913	·5	1·059	1·122
·9333	·8710	·6	1·072	1·148
·9226	·8511	·7	1·084	1·175
·9120	·8318	·8	1·096	1·202
·9016	·8128	·9	1·109	1·230
·8913	·7943	1·0	1·122	1·259
·8710	·7586	1·2	1·148	1·318
·8511	·7244	1·4	1·175	1·380
·8318	·6918	1·6	1·202	1·445
·8128	·6607	1·8	1·230	1·514
·7943	·6310	2·0	1·259	1·585
·7762	·6026	2·2	1·288	1·660
·7586	·5754	2·4	1·318	1·738
·7413	·5495	2·6	1·349	1·820
·7244	·5248	2·8	1·380	1·905
·7079	·5012	3·0	1·413	1·995
·6683	·4467	3·5	1·496	2·239
·6310	·3981	4·0	1·585	2·512
·5957	·3548	4·5	1·679	2·818
·5623	·3162	5·0	1·778	3·162
·5309	·2818	5·5	1·884	3·548
·5012	·2512	6	1·995	3·981
·4467	·1995	7	2·239	5·012
·3981	·1585	8	2·512	6·310
·3548	·1259	9	2·818	7·943
·3162	·1000	10	3·162	10·000
·2818	·07943	11	3·548	12·59
·2512	·06310	12	3·981	15·85
·2239	·05012	13	4·467	19·95
·1995	·03981	14	5·012	25·12
·1778	·03162	15	5·623	31·62

DECIBEL CONVERSION TABLE

Ratio Down			*Ratio Up*	
VOLTAGE	*POWER*	*DECIBELS*	*VOLTAGE*	*POWER*
·1585	·02512	16	6·310	39·81
·1413	·01995	17	7·079	50·12
·1259	·01585	18	7·943	63·10
·1122	·01259	19	8·913	79·43
·1000	·01000	20	10·000	100·00
·07943	·006310	22	12·59	158·5
·06310	·003981	24	15·85	251·2
·05012	·002512	26	19·95	398·1
·03981	·001585	28	25·12	631·0
·03162	·001000	30	31·62	1,000
·02512	·0006310	32	39·81	1,585
·01995	·0003981	34	50·12	2,512
·01585	·0002512	36	63·10	3,981
·01259	·0001585	38	79·43	6,310
·01000	·0001000	40	100·00	10,000
·007943	·00006310	42	125·9	15,850
·006310	·00003981	44	158·5	25,120
·005012	·00002512	46	199·5	39,810
·003981	·00001585	48	251·2	63,100
·003162	·00001000	50	316·2	100,000
·002512	$6{\cdot}310 \times 10^{-6}$	52	398·1	158,500
·001995	$3{\cdot}981 \times 10^{-6}$	54	501·2	251,200
·001585	$2{\cdot}512 \times 10^{-6}$	56	631·0	398,100
·001259	$1{\cdot}585 \times 10^{-6}$	58	794·3	631,000
·001000	10^{-6}	60	1,000	10^{6}
·0005623	$3{\cdot}162 \times 10^{-7}$	65	1,778	$3{\cdot}162 \times 10^{6}$
·0003162	10^{-7}	70	3,162	10^{7}
·0001778	$3{\cdot}162 \times 10^{-8}$	75	5,623	$3{\cdot}162 \times 10^{7}$
·0001000	10^{-8}	80	10,000	10^{8}
·00005623	$3{\cdot}162 \times 10^{-9}$	85	17,780	$3{\cdot}162 \times 10^{8}$
·00003162	10^{-9}	90	31,620	10^{9}
·00001000	10^{-10}	100	100,000	10^{10}
$3{\cdot}162 \times 10^{-6}$	10^{-11}	110	316,200	10^{11}
10^{-6}	10^{-12}	120	10^{6}	10^{12}
$3{\cdot}162 \times 10^{-7}$	10^{-13}	130	$3{\cdot}162 \times 10^{6}$	10^{13}
10^{-7}	10^{-14}	140	10^{7}	10^{14}

MASTER
MA30915

Printed in England 2[K